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Terms	Documents
ink jet and (channel or electrode) same (distance or interval or pitch or density or spacing or dpi) and (mu.m or micron or micrometer)	25

Database: US Patents Full-Text Database; US Pre-Grant Publication Full-Text Database; JPO Abstracts Database; EPO Abstracts Database; Derwent World Patents Index; IBM Technical Disclosure Bulletins

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Set Name side by side	Query	Hit Count	Set Name result set
DB=JPAB,EPAB,DWPI; PLUR=YES; OP=ADJ			
L45	ink jet and (channel or electrode) same (distance or interval or pitch or density or spacing or dpi) and (mu.m or micron or micrometer)	25	L45
L44	ink jet and (channel or electrode) same (distance or interval or pitch or density or spacing or dpi)	1199	L44
L43	(channel or electrode) same (distance or interval or pitch or density or spacing or dpi) same mu.m	2	L43
L42	ink jet and (channel or electrode) same (distance or interval or pitch or density or spacing or dpi) same mu.m	0	L42
L41	ink jet and (channel or electrode) near7 (distance or interval or pitch or density or spacing or dpi) near10 mu.m	0	L41

DB=USPT,PGPB,JPAB,EPAB,DWPI; PLUR=YES; OP=ADJ

L40	l39 and l38	13	L40
L39	('6443560'| '6371598'| '6412916'| '6350023'| '6168263'| '6164759'| '6213590'| '5764255'| '5992978'| '5912684'| '4536097'| '4368476'| '4162502')[ABPN1,NRPN,PN,WKU]	27	L39
L38	l1 and (channel or electrode) near7 (distance or interval or pitch or density or spacing or dpi) near10 mu.m	193	L38

DB=DWPI,EPAB,JPAB,PGPB,USPT; PLUR=YES; OP=ADJ

L37	"MU.M"!	290389	L37
L36	MU!	141842	L36

DB=USPT,PGPB,JPAB,EPAB,DWPI; PLUR=YES; OP=ADJ

L35	l9 and ".mu.m"	0	L35
L34	l9 and mu$	935	L34
L33	l9 and mu!	39	L33
L32	l9 and mu	39	L32
L31	l1 and (channel or electrode) near7 (distance or interval or pitch or density or spacing or dpi) near10 mu	1	L31
L30	l29 and l27	4	L30
L29	('4166277'| '6454401'| '6416175'| '6305787'| '6241341')[ABPN1,NRPN,PN,WKU]	10	L29
L28	L1 and (electrode or channel or pitch) near7 (dpi)	298	L28
L27	L1 and (electrode or channel) near7 (dpi)	75	L27
L26	L25 not l24	1	L26
L25	L23 and (electrode or channel) near7 (distance or interval or pitch or dpi)	12	L25
L24	L23 and (electrode or channel) near7 (distance or interval or pitch)	11	L24
L23	((347/41)!.CCLS.)	342	L23
L22	L1 and (electrode or channel) near7 between near7 (distance or interval or pitch) same (micron or micrometer)	27	L22
L21	L1 and (electrode or channel) near7 between near7 (distance or interval or pitch)	565	L21
L20	L19 not l18	11	L20
L19	L1 and (electrode or channel) near7 minimum near7 (distance or interval or pitch)	18	L19
L18	L1 and (electrode or channel) near7 between near7 minimum near7 (distance or interval or pitch)	9	L18
L17	L15 not l16	36	L17
L16	L15 not l14	932	L16
L15	((electrode or channel) same distance same 170)	968	L15
L14	ink jet and ((electrode or channel) same distance same 170)	36	L14

DB=USPT; PLUR=YES; OP=ADJ

L13	L1 and (electrode or channel) near5 170	51	L13
L12	L1 and (electrode or channel) near5 between near5 minimum near5 (distance)	4	L12
L11	L9 and (electrode or channel) near5 between near5 minimum near5 (distance)	0	L11
L10	L9 and (electrode or channel) near5 between near5 (distance)	47	L10
L9	L8 or l7 or l6	2427	L9
L8	((347/40 |347/41 |347/42)!.CCLS.)	837	L8
L7	((347/19 |347/20)!.CCLS.)	1019	L7
L6	((347/9 |347/10 |347/11 |347/12 |347/13)!.CCLS.)	845	L6
L5	L1 and (electrode or channel) near5 between near5 (distance)	408	L5
L4	L1 and (electrode or channel) near5 (distance)	829	L4
L3	L1 and (electrode or channel) near5 (distance or interval)	967	L3
L2	L1 and (electrode or channel) near5 (distance or interval or pitch)	1049	L2
L1	((347/2 |347/3 |347/4 |347/5 |347/6 |347/7 |347/8 |347/9 |347/10 |347/11 |347/12 |347/13 |347/14 |347/15 |347/16 |347/17 |347/18 |347/19 |347/20 |347/21 |347/22 |347/23 |347/24 |347/25 |347/26 |347/27 |347/28 |347/29 |347/30 |347/31 |347/32 |347/33 |347/34 |347/35 |347/36 |347/37 |347/38 |347/39 |347/40 |347/41 |347/42 |347/43 |347/44 |347/45 |347/46 |347/47 |347/48 |347/49 |347/50 |347/51 |347/52 |347/53 |347/54 |347/55 |347/56 |347/57 |347/58 |347/59 |347/60 |347/61 |347/62 |347/63 |347/64 |347/65 |347/66 |347/67 |347/68 |347/69 |347/70 |347/71 |347/72 |347/73 |347/74 |347/75 |347/76 |347/77 |347/78 |347/79 |347/80 |347/81 |347/82 |347/83 |347/84 |347/85 |347/86 |347/87 |347/88 |347/89 |347/90 |347/91 |347/92 |347/93 |347/94 |347/95 |347/96 |347/97 |347/98 |347/99 |347/100 |347/101 |347/102 |347/103 |347/104 |347/105 |347/106 |347/107)!.CCLS.)	12887	L1

END OF SEARCH HISTORY

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☐ 1. Document ID: US 6443560 B1

L40: Entry 1 of 13 File: USPT Sep 3, 2002

DOCUMENT-IDENTIFIER: US 6443560 B1
TITLE: Recording head and inkjet recording device having separately arranged ink chambers and ink discharge unit

US PATENT NO. (1):
6443560

Detailed Description Text (54):
When the configuration of the recording head 2 shown in FIGS. 2 to 6 in the foregoing is adopted, the intervals between the recording electrodes 11 become as wide as about 250 .mu.m, and therefore, in order to obtain a recording head for recording a highly precise image at high speed, it is necessary to pile up these ink discharge units 5 in several layers for arranging the recording electrodes 11 in a zigzag shape. FIG. 11 is a sectional view showing these ink discharge units 5 piled up in three layers. In an ink jet recording apparatus of a type in which the recording head 2 is fixed, the number n of layers required of the ink discharge units 5 is determined by a desired dot interval dl during printing and the interval d2 between the recording electrodes 11 existing on one head substrate, and is expressed by d2=dl.times.n. How to pile up line heads of n layers is to pile up such that the recording electrodes 11 are arranged to be shifted in a zigzag shape, thereby it is arranged that dots can be printed with desired pitches in a direction perpendicular to the conveying direction of the recording medium. In an ink jet recording apparatus of a type in which printing is performed while the recording head 2 is moving, since the printing speed and the exactness are improved with a larger number n of layers, the number n of layers is determined by the specifications of the recording apparatus.

Current US Original Classification (1):
347/55

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 2. Document ID: US 6412916 B1

L40: Entry 2 of 13 File: USPT Jul 2, 2002

DOCUMENT-IDENTIFIER: US 6412916 B1
TITLE: Ink jet printer

US PATENT NO. (1):
6412916

Detailed Description Text (14):
FIG. 4 is a sectional view in which the ink circulating path 12 shown in FIG. 3 has

been cut at the portion of an ink ejecting electrode 11. An aggregating electrode 13 is present throughout an upper surface of the ink circulating path 12, and on an opposite wall surface there are a large number of ink ejecting electrodes 11. By setting the aggregating electrode 13 at a higher potential than the ink ejecting electrodes 11, a colorant component contained in the circulating ink shifts to the surfaces of the electrodes 11 and aggregates. At this time, by spacing a tip end portion of the aggregating electrode 13 from the wall surface of the ink circulating path 12 which is orthogonal thereto, there is created an electric field component which advances toward tip ends of the ink ejecting electrodes 11, so that the ink which is larger in the degree of aggregation can be fed to the tip ends of the electrodes and can be ejected therefrom. If the ink ejecting electrodes 11 are each set to a width of 30 to 100 .mu.m and the electrode-to-electrode spacing is set at about 200 to 600 .mu.m, the ejection of ink from the electrodes 11 becomes stable and there will no longer be any electric discharge between adjacent electrodes 11. If the thickness of each ink ejecting electrode 11 is set at 20 .mu.m or more, a sufficient difference in height is formed on the ink circulating path 12, so that the adhering force of the ink to the surface of the ink circulating path becomes weak and therefore it becomes easier for the ink to fly out from the tip ends of the ink ejecting electrodes 11.

Detailed Description Text (15):
An opening portion 14 located near the tip end of each ink ejecting electrode 11 is narrow, and so there is little flow of ink despite the opening portion 14 being a part of the ink circulating path 12. Only when voltage is applied to each ink ejecting electrode 11 will the ink be drawn to near the opening portion 14 by an electric field and wet the tip end of the electrode 11. The length "a" of each ink ejecting electrode 11 is 1 to 3 mm and the distance "b" between the aggregating electrode 13 and the ink ejecting electrode 11 is 200 to 500 .mu.m. The larger the values of "a" and "b," the larger the amount of ink to be circulated, thus causing the problem that the amount of waste ink increases. On the other hand, if the value of "a" is set too small, there arises the problem that the aggregation degree of ink at the tip end of each ink ejecting electrode 11 becomes lower because of a small area which contributes to the aggregation of ink induced by an electrostatic field. If the value of "b" is set too small, there arises the problem that the flow path is blocked with ink which has aggregated and become higher in viscosity. It follows that there is an appropriate range with respect to the flow path size.

Current US Original Classification (1):
347/55

3. Document ID: US 6371598 B1

L40: Entry 3 of 13 File: USPT Apr 16, 2002

DOCUMENT-IDENTIFIER: US 6371598 B1
TITLE: Ink jet recording apparatus, and an ink jet head

US PATENT NO. (1):
6371598

Detailed Description Text (4):
Referring to FIGS. 1 and 3 in this embodiment, a gap holding means is formed by vibration chamber recesses 15 formed in second substrate 2 such that the gap between diaphragm 5 and the electrode disposed opposite thereto, i.e., length G (hereinafter the "gap length") of gap member 16, is the difference between the depth of recess 15 and the thickness of the electrode. It is to be noted that recesses may be alternatively formed in the bottom face of first substrate 1. In this embodiment, recess 15 is preferably etched to a depth of 0.3 .mu.m. The pitch of nozzle channels 11 is preferably 0.509 mm, and the width is preferably 60 .mu.m.

Detailed Description Text (7):
In the preferred embodiment, a gap holding means is formed by vibration chamber recesses 15 formed in the top surface of second substrate 2 such that the gap between diaphragm 5 and the individual electrode disposed opposite thereto, i.e., length G (see FIG. 3; hereinafter the "gap length") of gap member 16, is the difference between the depth of recess 15 and the thickness of the electrode 21. It is to be noted that recesses 15 may be formed in the bottom of first substrate 1 as an alternative embodiment of the invention. In the present embodiment, recess 15 is etched to a depth of 0.3 .mu.m. The pitch of nozzle channels 11 is 0.2 mm, and the width is 80 .mu.m.

Current US Original Classification (1):
347/54

4. Document ID: US 6350023 B1

L40: Entry 4 of 13 File: USPT Feb 26, 2002

DOCUMENT-IDENTIFIER: US 6350023 B1
TITLE: Fluid supply mechanism

US PATENT NO. (1):
6350023

Detailed Description Text (14):
Returning to FIG. 1, care must be taken to provide adequate ink flow to the entire printhead 2, while satisfying the constraints of an injection molding process. The size of the ink through wafer channels 12 at the back of the printhead 2 is approximately 100 .mu.m.times.50 .mu.m, and the spacing between through wafer channels 12 carrying different colors of ink is approximately 170 .mu.m. While features of this size can readily be molded in plastic (compact discs have micron sized features), in general to allow release of injection molded components, the height of the wall should not exceed the thickness of the wall by a large factor. The preferred embodiment overcomes these problems by using a hierarchy of progressively smaller ink channels.

Current US Original Classification (1):
347/85

5. Document ID: US 6213590 B1

L40: Entry 5 of 13 File: USPT Apr 10, 2001

DOCUMENT-IDENTIFIER: US 6213590 B1
TITLE: Inkjet head for reducing pressure interference between ink supply passages

US PATENT NO. (1):
6213590

Detailed Description Text (4):
Referring to FIGS. 1 and 3 in this embodiment, a gap holding means is formed by

vibration chamber recesses 15 formed in second substrate 2 such that the gap between diaphragm 5 and the electrode disposed opposite thereto, i.e., length G (hereinafter the "gap length") of gap member 16, is the difference between the depth of recess 15 and the thickness of the electrode. It is to be noted that recesses may be alternatively formed in the bottom face of first substrate 1. In this embodiment, recess 15 is preferably etched to a depth of 0.3 .mu.m. The pitch of nozzle channels 11 is preferably 0.509 mm, and the width is preferably 60 .mu.m.

Detailed Description Text (7):
In the preferred embodiment, a gap holding means is formed by vibration chamber recesses 15 formed in the top surface of second substrate 2 such that the gap between diaphragm 5 and the individual electrode disposed opposite thereto, i.e., length G (see FIG. 3; hereinafter the "gap length") of gap member 16, is the difference between the depth of recess 15 and the thickness of the electrode 21. It is to be noted that recesses 15 may be formed in the bottom of first substrate 1 as an alternative embodiment of the invention. In the present embodiment, recess 15 is etched to a depth of 0.3 .mu.m. The pitch of nozzle channels 11 is 0.2 mm, and the width is 80 .mu.m.

Current US Original Classification (1):
347/54

6. Document ID: US 6168263 B1

L40: Entry 6 of 13 File: USPT Jan 2, 2001

DOCUMENT-IDENTIFIER: US 6168263 B1
TITLE: Ink jet recording apparatus

US PATENT NO. (1):
6168263

Detailed Description Text (15):
The substrates 1, 2 and 3 are assembled to constitute an ink-jet head 12 as shown in FIG. 2. Further, oscillation circuits 26 are respectively correspondingly connected between the terminal portions 33 of the electrodes 31 and the intermediate substrate 2 to thereby constitute the ink-jet recording apparatus 10 having a lamination structure according to the present invention. Ink 11 is supplied from the ink tank (not shown) to the inside of the intermediate substrate 2 through the ink supply port 14, so that the ink cavity 8, the ejection chambers 6 and the like are filled with the ink. The distance c between the electrode 31 and the corresponding diaphragm 5 is kept to be about 1 .mu.m. In FIG. 2, the reference numeral 13 designates an ink drop ejected designates from the nozzle opening 4, and 15 designates recording paper. The ink used is prepared by dissolving/dispersing a surface active agent such as ethylene glycol and a dye (or a pigment) into a main solvent such as water, alcohol, toluene, etc. Alternatively, hot-melt ink may be used if a heater or the like is provided in this apparatus.

Detailed Description Text (36):
The allowable region of ink ejection as shown in FIG. 5A can be calculated on the basis of the formulae (2) and (5). FIG. 5A shows the relationship between the short side length 2a(mm) and the driving voltage (V) in the case where the long side length b of the silicon diaphragm, the thickness h thereof and the distance c between the diaphragm and the electrode are selected to be 5 mm, 80 .mu.m and 1 .mu.m respectively. The ejection allowable region 30 is shown by the oblique lines in FIG. 5A when the jet (ejection) pressure P is 0.3 atm.

Detailed Description Text (103):
The ink-jet head of the preferred embodiment is constructed as follows. First, the middle substrate 200 and the lower substrate 300 are anode bonded by applying an 800V

source at 340.degree. C. between them. Then, the middle substrate 200 and the upper substrate 100 are connected, resulting in the assembled ink-jet head shown in FIGS. 18A and 18C. After anode bonding, the thickness of oxide thin film 2401 and difference between the depth of the dent 1500 and the thickness of the electrode 2100 constitutes the electrical gap length (here, approximately 0.285 .mu.m). Distance G1 (air gap) between the diaphragm 500 and the electrode 2100 is approximately 0.175 .mu.m.

Detailed Description Text (260):
In the preferred embodiment, a gap holding means is formed by vibration chamber recesses 5215 formed in the top surface of second substrate 522 such that the gap between diaphragm 525 and the individual electrode disposed opposite thereto, i.e., length G (see FIG. 54; hereinafter the "gap length") of gap member 5216, is the difference between the depth of recess 5215 and the thickness of the electrode 5221. It is to be noted that recesses 5215 may be formed in the bottom of first substrate 521 as an alternative embodiment of the invention. In the present embodiment, recess 5215 is etched to a depth of 0.3 .mu.m. The pitch of nozzle channels 5211 is 0.2 mm, and the width is 80 .mu.m.

Current US Original Classification (1):
347/54

7. Document ID: US 6164759 A

L40: Entry 7 of 13 File: USPT Dec 26, 2000

DOCUMENT-IDENTIFIER: US 6164759 A
TITLE: Method for producing an electrostatic actuator and an inkjet head using it

US PATENT NO. (1):
6164759

Detailed Description Text (7):
The substrates 1, 2 and 3 are assembled to constitute an ink-jet head 12 as shown in FIG. 2. Further, oscillation circuits 26 are respectively correspondingly connected between the terminal portions 33 of the electrodes 31 and the intermediate substrate 2 to thereby constitute the ink jet recording apparatus 10 having a lamination structure according to the present invention. Ink 11 is supplied from the ink tank (not shown) to the inside of the intermediate substrate 2 through the ink supply port 14, so that the ink cavity 8, the ejection chambers 6 and the like are filled with the ink. The distance c between the electrode 31 and the corresponding diaphragm 5 is kept to be about 1 .mu.m. In FIG. 2, the reference numeral 13 designates an ink drop ejected designates from the nozzle opening 4, and 15 designates recording paper. The ink used is prepared by dissolving/dispersing a surface active agent such as ethylene glycol and a dye (or a pigment) into a main solvent such as water, alcohol, toluene, etc. Alternatively, hot-melt ink may be used if a heater or the like is provided in this apparatus.

Detailed Description Text (30):
The allowable region of ink ejection as shown in FIG. 5A can be calculated on the basis of the formulae (2) and (5). FIG. 5A shows the relationship between the short side length 2a(mm) and the driving voltage (V) in the case where the long side length b of the silicon diaphragm, the thickness h thereof and the distance c between the diaphragm and the electrode are selected to be 5 mm, 80 .mu.m and 1 .mu.m respectively. The ejection allowable region 30 is shown by the oblique lines in FIG. 5A when the jet (ejection) pressure P is 0.3 atm.

Detailed Description Text (97):
The ink-jet head of the preferred embodiment is constructed as follows. First, the middle substrate 200 and the lower substrate 300 are anode bonded by applying an 800V

source at 340.degree. C. between them. Then, the middle substrate 200 and the upper substrate 100 are connected, resulting in the assembled ink-jet head shown in FIGS. 18A and 18C. After anode bonding, the thickness of oxide thin film 2401 and difference between the depth of the dent 1500 and the thickness of the electrode 2100 constitutes the electrical gap length (here, approximately 0.285 .mu.m). Distance G1 (air gap) between the diaphragm 500 and the electrode 2100 is approximately 0.175 .mu.m.

Detailed Description Text (254):
In the preferred embodiment, a gap holding means is formed by vibration chamber recesses 5215 formed in the top surface of second substrate 522 such that the gap between diaphragm 525 and the individual electrode disposed opposite thereto, i.e., length G (see FIG. 54; hereinafter the "gap length") of gap member 5216, is the difference between the depth of recess 5215 and the thickness of the electrode 5221. It is to be noted that recesses 5215 may be formed in the bottom of first substrate 521 as an alternative embodiment of the invention. In the present embodiment, recess 5215 is etched to a depth of 0.3 .mu.m. The pitch of nozzle channels 5211 is 0.2 mm, and the width is 80 .mu.m.

Detailed Description Text (331):
In the preferred embodiment, a gap holding means is formed by vibration chamber recesses 10015 formed in the bottom surface of the first substrate 1001 such that the gap between diaphragm 1005 and the individual electrode disposed opposite thereto, i.e., length G (see FIG. 69; hereinafter the "gap length") of gap member 10016, is equal to the difference between the depth of recess 10015 and the thickness of the electrode. In this embodiment, recess 10015 is etched to a depth of 0.6 .mu.m. It is to be noted that the pitch of nozzle channels 10011 is 0.72 mm, and the width is 70 .mu.m.

Current US Original Classification (1):
347/54

Current US Cross Reference Classification (2):
347/68

8. Document ID: US 5992978 A

L40: Entry 8 of 13 File: USPT Nov 30, 1999

DOCUMENT-IDENTIFIER: US 5992978 A
TITLE: Ink jet recording apparatus, and an ink jet head manufacturing method

US PATENT NO. (1):
5992978

Detailed Description Text (4):
Referring to FIGS. 1 and 3 in this embodiment, a gap holding means is formed by vibration chamber recesses 15 formed in second substrate 2 such that the gap between diaphragm 5 and the electrode disposed opposite thereto, i.e., length G (hereinafter the "gap length") of gap member 16, is the difference between the depth of recess 15 and the thickness of the electrode. It is to be noted that recesses may be alternatively formed in the bottom face of first substrate 1. In this embodiment, recess 15 is preferably etched to a depth of 0.3 .mu.m. The pitch of nozzle channels 11 is preferably 0.509 mm, and the width is preferably 60 .mu.m.

Detailed Description Text (7):
In the preferred embodiment, a gap holding means is formed by vibration chamber recesses 15 formed in the top surface of second substrate 2 such that the gap between diaphragm 5 and the individual electrode disposed opposite thereto, i.e., length G (see FIG. 3; hereinafter the "gap length") of gap member 16, is the difference between the

depth of recess 15 and the thickness of the electrode 21. It is to be noted that recesses 15 may be formed in the bottom of first substrate 1 as an alternative embodiment of the invention. In the present embodiment, recess 15 is etched to a depth of 0.3 .mu.m. The pitch of nozzle channels 11 is 0.2 mm, and the width is 80 .mu.m.

Current US Original Classification (1):
347/54

Current US Cross Reference Classification (1):
347/93

9. Document ID: US 5912684 A

L40: Entry 9 of 13 File: USPT Jun 15, 1999

DOCUMENT-IDENTIFIER: US 5912684 A
TITLE: Inkjet recording apparatus

US PATENT NO. (1):
5912684

Detailed Description Text (7):
The substrates 1, 2 and 3 are assembled to constitute an ink-jet head 12 as shown in FIG. 2. Further, oscillation circuits 26 are respectively correspondingly connected between the terminal portions 33 of the electrodes 31 and the intermediate substrate 2 to thereby constitute the ink-jet recording apparatus 10 having a lamination structure according to the present invention. Ink 11 is supplied from the ink tank (not shown) to the inside of the intermediate substrate 2 through the ink supply port 14, so that the ink cavity 8, the ejection chambers 6 and the like are filled with the ink. The distance c between the electrode 31 and the corresponding diaphragm 5 is kept to be about 1 .mu.m. In FIG. 2, the reference numeral 13 designates an ink drop ejected designates from the nozzle opening 4, and 15 designates recording paper. The ink used is prepared by dissolving/dispersing a surface active agent such as ethylene glycol and a dye (or a pigment) into a main solvent such as water, alcohol, toluene, etc. Alternatively, hot-melt ink may be used if a heater or the like is provided in this apparatus.

Detailed Description Text (28):
The allowable region of ink ejection as shown in FIG. 5A can be calculated on the basis of the formulae (2) and (5). FIG. 5A shows the relationship between the short side length 2a(mm) and the driving voltage (V) in the case where the long side length b of the silicon diaphragm, the thickness h thereof and the distance c between the diaphragm and the electrode are selected to be 5 mm, 80 .mu.m and 1 .mu.m respectively. The ejection allowable region 30 is shown by the oblique lines in FIG. 5A when the jet (ejection) pressure P is 0.3 atm.

Detailed Description Text (95):
The ink-jet head of the preferred embodiment is constructed as follows. First, the middle substrate 200 and the lower substrate 300 are anode bonded by applying an 800V source at 340.degree. C. between them. Then, the middle substrate 200 and the upper substrate 100 are connected, resulting in the assembled ink-jet head shown in FIGS. 18(a) and 18(c). After anode bonding, the thickness of oxide thin film 2401 and difference between the depth of the dent 1500 and the thickness of the electrode 2100 constitutes the electrical gap length (here, approximately 0.285 .mu.m). Distance G1 (air gap) between the diaphragm 500 and the electrode 2100 is approximately 0.175 .mu.m.

Detailed Description Text (251):
In the preferred embodiment, a gap holding means is formed by vibration chamber

recesses 5215 formed in the top surface of second substrate 522 such that the gap between diaphragm 525 and the individual electrode disposed opposite thereto, i.e., length G (see FIG. 54; hereinafter the "gap length") of gap member 5216, is the difference between the depth of recess 5215 and the thickness of the electrode 5221. It is to be noted that recesses 5215 may be formed in the bottom of first substrate 521 as an alternative embodiment of the invention. In the present embodiment, recess 5215 is etched to a depth of 0.3 .mu.m. The pitch of nozzle channels 5211 is 0.2 mm, and the width is 80 .mu.m.

Current US Original Classification (1):
347/54

Current US Cross Reference Classification (1):
347/68

CLAIMS:

8. An ink jet head comprising a single or a plurality of nozzle for ejecting ink drops, a vibration chamber led to each of said nozzle, a diaphragm constituting at least one wall of said vibration chamber, and a driving means for generating a deformation in said diaphragm, wherein said driving means is an electrode for static-electrically deforming the diaphragm and an opposed distance between the diaphragm and said electrode being 0.05 .mu.m or more than 0.05 .mu.m, and 2.0 .mu.m or less than 2.0 .mu.m, wherein said vibration chamber has a first volume V.sub.1 prior to being deformed by said drive means and a second volume V.sub.2 after being deformed by said drive means, and wherein 2.ltoreq.V.sub.1 /.DELTA.V.ltoreq.8, wherein .DELTA.V is defined as the first volume V.sub.1 less the second volume V.sub.2.

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 10. Document ID: US 5764255 A

L40: Entry 10 of 13 File: USPT Jun 9, 1998

DOCUMENT-IDENTIFIER: US 5764255 A
TITLE: Ink jet head with a deformable piezoelectric vibrating plate

US PATENT NO. (1):
5764255

Detailed Description Text (5):
Each orifice 1 and each pressure chamber 2 constitute one channel, and 50 to 100 channels are arranged at a pitch of about 400 .mu.m, for example.

Current US Original Classification (1):
347/70

Current US Cross Reference Classification (1):
347/94

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 11. Document ID: US 4536097 A

L40: Entry 11 of 13 File: USPT Aug 20, 1985

DOCUMENT-IDENTIFIER: US 4536097 A
TITLE: Piezoelectrically operated print head with channel matrix and method of manufacture

US PATENT NO. (1):
4536097

Detailed Description Text (4):
FIG. 3 shows a cross-section through the channel matrix according to FIG. 2. A nickle foil serves as the carrier plate 17. The piezoelectric material 20-27 is applied in strip-like form. These strips are provided in pairs with electrical contacts 30 through 33. The termination is formed by the cover plate 18 that, in this case, consists of a non-conductive material. Every second channel 34 through 36 formed is filled with an elastic material, for example silicone rubber. When, for example, the width of the piezoelectric strips is about 50 .mu.m and the spacing between the neighboring strips is the same, then there is a 200 .mu.m spacing of the write nozzles (the hollow channels 13 through 16). Thus, five write nozzles per mm are provided, and a very good recording quality is attainable therewith. The thickness of the strips can be of approximately the same order. The length of the channel matrix is preferably about 10 mm, in order to obtain a sufficiently great ink ejection without voltage amplitudes that are too high. The thickness of the carrier plates 17 and 18 amounts to approximately 20 .mu. m.

Current US Original Classification (1):
347/71

Current US Cross Reference Classification (2):
347/68

12. Document ID: US 4368476 A

L40: Entry 12 of 13 File: USPT Jan 11, 1983

DOCUMENT-IDENTIFIER: US 4368476 A
TITLE: Ink jet recording head

US PATENT NO. (1):
4368476

Detailed Description Text (24):
The thermal head member and the glass plate thus prepared were cemented together to form a multi-orifice head as shown in FIG. 6. The pitch between ink channels was 250 .mu.m. The outer wall surface containing the jet orifices of the multi-orifice head was polished, washed well with distilled water and dried. After all of the ink channels being filled with mercury, the polished surface was treated with a treating agent according to the invention to make the surface repellent against recording ink.

Current US Original Classification (1):
347/45

Current US Cross Reference Classification (1):
347/56

13. Document ID: US 4162502 A

L40: Entry 13 of 13 File: USPT Jul 24, 1979

DOCUMENT-IDENTIFIER: US 4162502 A
TITLE: Printer with electrostatic ink control

US PATENT NO. (1):
4162502

Detailed Description Text (1):
As illustrated in FIGS. 1 and 2 on a substrate 10 are formed hydrophilic strips 11, the spaces between being covered with a hydrophobic material at 12. A reservoir 13 supplies ink 14 which flows through a lateral orifice, or a series of orifices, 15. The strips 11 have a gap 16 near the end remote from the reservoir, this gap also filled with hydrophobic material 12. The strips 11 extend part way down the end face 17 of the substrate and an electrode 18 is formed under the ends of the strips 11. A paper sheet 19 is passed in close relationship to the strips 11, backed by a roller 20. The ink 14 feeds along the hydrophilic strip 11 to the gaps 16. When a voltage is applied to an electrode 18, the ink is urged across a gap 16 on to the end of a strip 11 and down the front face into contact with the paper. The paper and roller are omitted from FIG. 1 for clarity. In FIG. 2, ink is shown along the strip 11 to the gap 16 and also some ink is shown on the strip end, having passed over the material 12 in the gap 16 when a pulse was applied to the electrode 18. Any pattern can be printed, spot-by-spot, and the spacing between electrodes 18 can be of the order of 200 .mu.m for good resolution. The electrodes 18 are activated by conductors, which can comprise a common "ground" conductor 21 and separate conductors 22 formed on the substrate and extending to a contact position.

Current US Original Classification (1):
347/55

Current US Cross Reference Classification (2):
347/54

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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☐ 1. Document ID: US 6454401 B2

L30: Entry 1 of 4 File: USPT Sep 24, 2002

DOCUMENT-IDENTIFIER: US 6454401 B2
TITLE: Ink jet printing process and printing apparatus

US PATENT NO. (1):
6454401

Drawing Description Text (22):
FIG. 21 is a schematic view showing only one part of the ejection head using 4 sets of 100 dpi multi-channel head with 256 channels.

Detailed Description Text (148):
A printing apparatus shown in FIGS. 7 and 8 was used, where a circulation pump as the stirring means was used as in FIG. 3, the branch point had a shape of the type shown in FIG. 2(b), and the confluent point had a shape of the type shown in FIG. 4(c). Furthermore, four units of 150-dpi multi-channel heads each having 64 channels of the type shown in FIG. 17 were used and the heads each was disposed to array the ejection parts of 64 channels in the direction right angled to the axial direction of the drum.

Detailed Description Text (154):
Also, the image drawing and printing were performed in the same manner except for using a 150 dpi multi-channel head with 64 channels of the type shown in FIG. 19 in place of the ink jet head of the type shown in FIG. 17, as a result, good results were obtained similarly to the above.

Detailed Description Text (156):
Using a printing apparatus shown in FIG. 10, full color printing of one-side four-color printing was performed. A circulation pump was used as the stirring means as shown in FIG. 1 and the branch point between a branched large aperture pipeline and a small aperture pipeline had a shape of the type shown in FIG. 2(c). Four color inks described in Example 2 were used as the oil ink in four sets of ink jet drawing devices, respectively, and a 900 dpi image was drawn on coated paper by using 4 units of 100 dpi multi-channel heads with 256 channels of the type shown in FIG. 21 each disposed to array the ejection parts in parallel with the axis of the opposing drum, performing the main scanning by the rotation of the opposing drum, and sequentially moving the heads in the axial direction of the drum every each rotation. As a result, despite the common use of a pump for stirring and liquid feeding, a full color printed matter having a clear and high-quality image was obtained.

Detailed Description Text (158):
Using a printing apparatus shown in FIGS. 12 and 13, full color printing of one-side four-color printing was performed. A circulation pump was used as the stirring means as in FIG. 3, the branch point between a branched large aperture pipeline and a small aperture pipeline had a shape of the type shown in FIG. 2(c) and the confluent point had a shape of the type shown in FIG. 4(c). The oil inks were the same four color inks as used in Example 3. The ejection head used in this Example was a 600 dpi multi-channel head with 64 channels of the type shown in FIG. 17 and the head was disposed to array the ejection parts at an angle of about 60.degree. with respect to the running direction of the printing medium. The image data to be printed were transmitted to the image data arithmetic and control part and a 700 dpi image was formed on a paper sheet exclusive for ink jet printing by transporting a printing medium using the rotation of capstan rollers while moving the multi-channel head with

64 channels in the direction right angled to the transportation direction of the printing medium. Other operations were the same as in Example 1. As a result, despite the common use of a pump for stirring and liquid feeding, good full color printing of four colors could be attained.

Current US Original Classification (1):
347/89

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 2. Document ID: US 6416175 B2

L30: Entry 2 of 4 File: USPT Jul 9, 2002

DOCUMENT-IDENTIFIER: US 6416175 B2
TITLE: Computer-to-cylinder type lithographic printing method and apparatus

US PATENT NO. (1):
6416175

Detailed Description Text (131):
The recording head used in this example was of a 100 dpi (dot per inch), 64-channel type as shown in FIG. 7. FIG. 8 illustrates this head with ink meniscus-regulating plates 42 and 42' removed from the unit shown in FIG. 7 in order to describe the detail of the head structure. Here, a pump was used to circulate ink. An ink reservoir was arranged between the pump and ink inlet (I) for the ejecting head, and another reservoir between the ink recoverying path (O) and the ink tank. The ink was circulated by the difference of the static pressures at these reservoirs, and the ink temperature was kept at 35.degree. C. with a heater and a thermostat under the agitation with said pump. The pump for circulation acted also as an agitating member for ink to prevent precipitation and aggregation. Further, an optical density sensor was equipped in the ink path, the output signal from which was used to order ink dilution or the addition of an undiluted ink replenisher for density maintenance.

Current US Original Classification (1):
347/103

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
Draw Desc | Image

☐ 3. Document ID: US 6305787 B1

L30: Entry 3 of 4 File: USPT Oct 23, 2001

DOCUMENT-IDENTIFIER: US 6305787 B1
TITLE: Ink jet recording method

US PATENT NO. (1):
6305787

Detailed Description Text (65):
The oily ink IK, IC, IM, and IY were charged in the respective ink tanks of an ink jet recording apparatus having four ink jet heads shown in FIGS. 1 and 2. Each of the heads had 30 ejection electrodes at a density of 100 dpi. The tip of each electrode had a

width of 10 .mu.m. The distance between the ejection electrodes and the opposite electrode was set at 1.0 mm. The ink on the ejection part was irradiated with light from a 100 W white light source (Cold Light HLS2100R, produced by HOYA Corp.) while applying a bias voltage, varying from 2 to 3 kV depending on the ink, between the ejection electrodes and the opposite electrode. In carrying out ink jet recording, the head was moved at a pitch of 600 dpi to perform interlacing image formation.

Detailed Description Text (75):
The recording head had 256 ejection electrodes at a density of 150 dpi. The tip of the ejection part had a width of 10 .mu.m and a curvature radius of 10 .mu.m. The distance between the ejection electrodes and the opposite electrode was set at 1.0 mm. With a bias voltage of 2 kV being applied between the ejection electrodes and the opposite electrode, a 10 mW LED array (wavelength: 680 nm) placed near the ejection part was made to emit light from the entire surface to irradiate the ink on the ejection parts. A voltage of 350 V was applied to the ejection electrodes in accordance with image data having been processed by color separation. The pulse width of the applied ejection voltage was varied from 50 to 150 .mu.sec in 256 steps, and image formation was performed in 256 steps per dot at a dot density of 600 dpi.

Current US Original Classification (1):
347/51

4. Document ID: US 6241341 B1

L30: Entry 4 of 4 File: USPT Jun 5, 2001

DOCUMENT-IDENTIFIER: US 6241341 B1
TITLE: Ink jet recording method

US PATENT NO. (1):
6241341

Detailed Description Text (66):
The oily ink IK, IC, IM, and IY were charged in the respective ink tanks of an ink jet recording apparatus having four ink jet heads shown in FIGS. 1 and 2. Each of the heads had 30 ejection electrodes at a density of 100 dpi. The tip of each electrode had a width of 10 .mu.m. The distance between the ejection electrodes and the opposite electrode was set at 1.0 mm.

Detailed Description Text (79):
The recording head had 256 ejection electrodes at a density of 150 dpi. The tip of each ejection part had a width of 10 .mu.m and a curvature radius of 10 .mu.m. The distance between the ejection electrodes and the opposite electrode, on which the plate material was held, was set at 1.0 mm. With a bias voltage of 2.5 kV being applied between the ejection electrodes and the opposite electrode, ink on the ejection electrodes was irradiated in accordance with image data having been processed by color separation by scanning with a polygon mirror using a 100 mW LD laser (wavelength: 680 nm) as a light source, whereby the ink was ejected from the ejection parts to form a feathering-free high definition image on the plate material. The dots had a diameter of about 45 .mu.m and were about 1.5 .mu.m thick under SEM observation. After the image was fixed by hot air in a drier, offset printing was carried out on a printing machine Hamada VS34A (Hamada Insatsu Kikai) using the resulting printing plate. The resulting prints, even after continuously obtaining 3,000 copies, showed an extremely clear image without causing dot missing and scratches.

Current US Original Classification (1):
347/51

Current US Cross Reference Classification (1):

347/55

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | KWIC
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